RBW Comments on *Monitoring Well Installation Work Plan, Red Hill Bulk Fuel Storage Facility*

Page: 1-5, second to the last paragraph, first sentence

This a minor point for the purposes well installation but is important for vadose zone transport, although the lava beds are "near horizontal" they do have dip. Characterizing the strike and dip of the lava flows is important for understanding any product migration in the vadose zone outside of the concrete cocoon. Strike dip of the lava beds should be part of the overall hydrogeologic investigation.

Page: 1-6, Section 1.2.1.4, second paragraph, first sentence

"Groundwater in Hawaii exists in two principal aquifer types", this description fails to mention high-level dike confined groundwater that is a principal aquifer type in Hawaii.

Page: 1-7, Section 1.2.2, second paragraph, first sentence

Two issues:

1) Downgradient has not been conclusively defined for this site. Defining the groundwater gradient is one the major goals of AOC – Task 7 and one reason that these new wells are being installed. It would be more accurate to state "the assumed down gradient direction" or similar since at this point since we don't know regional gradient beneath the Facility. The blue arrow on the figures is consistent with that shown in USGS publications. However, these publications are based on conceptual models developed decades ago and without the new water level data that has been, and will be acquired by Red Hill investigations.

2) The stated distances from USTs to the Red Hill Shaft in this and other Red Hill planning documents varies from <2000 to >4000 ft. The distance from the east end of the Red Hill Shaft infiltration gallery to UST 1 is about 1,500 ft, while the distance from west end of the infiltration gallery to UST 20 is about 4,500 ft. Some consistency needs to be used when describing this important parameter. It seems the shortest distance is the greatest concern when considering risk.

Page: 2-1, Section 2.2, 2.3 and 3.3

Sections 2.2 and 2.3 states that soil samples will only be collected if soil is encountered at an elevation below the bottom on the tanks or if contaminated soil is encountered. Section 3.3 states that soils samples will be collected at depths below 100 ft bgs. There is inconsistency, but the latter is a more conservative approach.

Page 3-3, Figure 3

Minor point, but it does seem strange that the figure has the Halawa Shaft completed in the alluvium when it is actually completed in the basalt. Also, the figure shows RHMW11 completed in the alluvium, while the Work Plan states that it will be completed in the basalt.

Page 3-8, Section 3.2.3

Checks for perched should occur more frequently than at the beginning and end of the day. Any perched water zone will likely not be very thick and it would be easy to drill through it unless the field crew is paying close attention. Inspection of rock cores for weathering or other indications of poor permeability might can provide an indication that the bore hole needs to be checked for perched water. Perched groundwater, likely drainage from Halawa Stream, was encountered when drilling RHMW04 and could be encountered in RHMW08 and RHMW11.

Page 3-11, Section 3.3

This is not consistent with the soil sampling plan stated in Section 2.2 and 2.3. Section 3.3 states that samples will be collected from any soil encountered below 100 ft bgs seems to be the better plan.

Page 3-12, Section 3.5 and SOP I-I – Land Surveying

The surveying procedures in these sections are suitable for the majority of the environmental investigation sites managed by the Navy. The Navy has chosen characterizing the groundwater gradient over an area extending from the Moanalua Ridge to west of the North Halawa Valley as the approach to evaluate possible migration paths of contamination. This is a regional groundwater problem that spans two aquifer systems. The needs of the Red Hill investigation require that the water level elevations relative to those at the Facility be measured accurately over distances of miles. This is a difficult undertaking. Lack of precise Top of Casing Elevations (TOC) of the wells has been a problem with Red Hill investigations from the beginning. Two efforts have been made to resolve this issue, TEC in 2009 and USGS in 2015. Both of these efforts relied on GPS that has vertical accuracies in the tenths of feet. It is also interesting to note that two different optical surveys that measured the elevation of RHMW01 in relation to OWDFMW1 came out with different values. In the 2006 the surveyed TOC elevation of RHMW01 was 36.43 ft lower than the TOC elevation of OWDFMW1. In the 2009 survey done after the installation of RHMW05, the surveyed difference in elevation was 36.11 ft. This is a difference of 0.32 ft between the surveys over a distance of 2,500 ft, which is significant when trying to compute groundwater gradient. As also recommended by the USGS, the Navy needs to consult with the National Geodetic Survey and develop a plan to accurately measure the TOC elevations of all of the observation wells used in this and previous Red Hill groundwater gradient investigations.

Page 5-3, Table 5-2

The purpose of this table is unclear. The matrix is listed as solid rather than soil. Yet the tests to be performed are soil tests. If this is for rock core testing it seems the tests stated are not appropriate. If it is for soil analysis then soil should be listed as the matrix. But it does seem difficult to collect soil cores with rock coring rig. This seems strange.